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2. Patent application number *(The Patent Office will fill in this pa)* — 9921049.4 — -7 SEP 1999

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5621 BA EINDHOVEN
THE NETHERLANDS

Patents ADP Number (*if you know it*) ~~06328418700~~ 7419294001

If the applicant is a corporate body, give the country/state of its incorporation — THE NETHERLANDS

4. Title of the invention — CLUSTERED NETWORKED DEVICES

5. Name of your agent (*if you have one*)
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ANDREW GORDON WHITE
Philips Corporate Intellectual Property
Cross Oak Lane
Redhill
Surrey
RH1 5HA

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Country	Priority Application number (*if you know it*)	Date of filing (*day/month/year*)

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Description	7	(x2)
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DESCRIPTION

CLUSTERED NETWORKED DEVICES

The present invention relates to networked systems composed of a plurality of devices clustered for the exchange of data and control messages formatted according to predetermined protocols and, in particular although not essentially, to such systems where inter-device communication between some of the devices is via wireless link. The invention further relates to devices for use in groups or clusters to form such systems.

Networked interconnection of devices has long been known and used, starting from basic systems where different system functions have been provided by separate units, for example hi-fi systems or security systems having detectors, a control panel and one or more alarm sounders. A development has been the so-called home bus systems where a greater variety of products have been linked with a view to providing enhanced overall functionality in for example domestic audio/video apparatus coupled with a home security system and the use of telephone. An example of such a home bus system is the domestic digital bus (D2B), the communications protocols for which have been issued as standard IEC 1030 by the International Electrotechnical Commission in Geneva, Switzerland. The D2B system provides a single wire control bus to which all devices are interfaced with messages carried between the various devices of the system in a standardised form of data packet.

With all such domestic equipment interconnection schemes, there is a problem of connection to apparatus not supporting the communications protocols of the scheme. As an example, a user may have a music system comprising interconnected units such as a compact disc (CD) player, amplifier, tuner and cassette player which communicate with each other using a first set of communications protocols, together with an audio visual system comprising for example a television, video recorder and satellite receiver which communicate

using a second set of protocols. In the absence of a certain degree of compatibility with existing systems, a user may be faced with having to replace many items at one time. One way to reduce this problem is to provide a gateway device which supports two or more sets of communications protocols and can "translate" messages between them, as described in US Patent 5,754,548 (Hoekstra et al), where D2B is used as a subsystem within a home electronic bus (HEB) system.

As is also described in US 5,754,548, such gateway devices can be used as part of a link between two clusters of bus-connected devices supporting the same communications protocols, but with different protocols governing communications on the link between the clusters. The link between the clusters may, for example, comprise a wireless (infra-red or RF) channel between the two gateway devices, whilst the cluster devices themselves are hard wired to respective serial data buses.

It is an object of the present invention to provide a networked system of devices including one or more communications links capable of handling digital data.

In accordance with the present invention there is provided a networked communications system and an apparatus for use as a device in such a communications system as defined in the claims attached hereto, to which the readers attention is now directed.

Further features and advantages of the present invention will become apparent from reading of the description of preferred embodiments of the invention, given by way of example only and with reference to the accompanying drawings, in which:

Figure 1 represents an arrangement of devices forming three linked clusters;

Figure 2 shows a pair of clusters using a different interconnect mechanism to the arrangement of Figure 1; and

Figure 3 shows three clusters using a still further interconnect

mechanism to the arrangements of either Figure 1 or Figure 2.

A first arrangement of interconnected devices is shown in Figure 1, with the devices being divided into three clusters 10, 20, 30, each based around a respective bus 18, 28, 38 supporting communication in accordance with IEEE Standard 1394 connect and communications protocols. In the following examples, reference is made to various communications protocols including IEEE 1394, IEEE 802.11, and HAVi (the Home Audio/Video interoperability standard based around 1394), and the disclosure of the specification of these various protocols is incorporated herein by reference. As will be recognised by the skilled reader, however, conformance with such protocols is not essential to the operation of the present invention.

The devices in the first cluster 10 comprise a set-top box (STB) 11, a first digital video recorder (DVHS-1) 12, a digital versatile disc (DVD) player 13 and an RF send and receive unit 19 which acts as a gateway device for the first cluster. The devices in the second cluster 20 comprise a first television set (TV-1) 21, a second digital video recorder (DVHS-2) 12 and an RF send and receive unit 29 which acts as a gateway device for the second cluster. The devices in the third cluster 30 comprise a second television set (TV-2) 31, a third digital video recorder (DVHS-3) 32, and an RF send and receive unit 39 which acts as a gateway device for the third cluster.

The second and third clusters 20, 30 communicate with the first 10 via respective RF links 41, 42 between the gateway devices at data rates of up to 8Mbit/sec. At these rates, digital video transmitted from one cluster to another may be compressed according to the known MPEG standards. HAVi commands may also be exchanged between the clusters as shown: note that the channel for these commands may be integrated with the RF channel or it may be separate.

In the system of Figure 1, the main value of the cordless link is for presentation, namely getting content from a source (such as the STB 11 in the first cluster) to the point of consumption (e.g. the TV-1 in the second cluster). This is particularly relevant where the source is tethered to a delivery medium,

such as cable, terrestrial/satellite antenna, phone line, etc.

A handheld PIA-like unit may be used for TV viewing although this is not necessarily of value since most rooms will have a TV anyway. PIA units have compelling value for Internet Surfing and home control, however, and they also are useful for supporting interactive TV (e.g. background information to advertisements, TV shows, etc.).

For true mobility within the home, (e.g. using a PIA-type unit) the TV picture should be stable when stationary; however, when moving some flutter is probably acceptable, and this is achievable using the high frequency RF link and MPEG compression.

In such systems, related issues include the need to protect the cordless signal from casual eavesdropping, particularly for pay-per-view content; a need to support interactive services (e.g. based on Java, MHEG); and a need to retain synchronisation between audio and video - for example, if these components are sent via separate routes.

In connection with access to the MPEG stream, some STB designs may decode right down to YC / CVBS / RGB allowing no access to the MPEG stream itself, whilst support for 1394/HAVi presumes that products are 1394/HAVi equipped which may not always be the case.

Considering the RF related issues, and beginning with those relating to MPEG streaming, for correct timing of audio and video, the MPEG 90kHz reference clock needs to be conveyed to the receiver via the RF channel. In order to broadcast to several receivers, there is no problem if all the receivers are on the same 1394 bus (i.e. in the same cluster) but where there are several clusters, it is recommended to use a dedicated MPEG stream to each, although the gateway device for the cluster sending out the MPEG streams (the source 1394 cordless AV adapter node) has to be able to configure this streaming.

In terms of presentation issues, to protect against possible errors caused by the radio channel, duplicate MPEG streams may be sent. To protect against possible delay caused by the radio channel the content could be 'pushed' at a "faster than realtime" rate to temporary storage at the receive

side. It is noted that DVD has the unique issue of high bandwidth graphic overlay which demands massive radio bandwidth for real-time transfer - this issue is beyond the scope of the present application, however.

In terms of recording or archiving, the streaming may be given a lower priority for the radio bandwidth, assuming sufficient 'spooling' storage is available on the sending side of the link (this helps with bandwidth management). To ensure a robust result, improved error protection may also be used (e.g. full acknowledged packet transfer).

Products will not generally be isolated - they will be part of a wired 1394 cluster (even if only consisting of 2 products/devices); however, the basic requirement of presentation is to communicate from one product to another, either within the same 1394 cluster, or between clusters. It is not a necessary requirement that clusters need to communicate one to another at the 1394 level.

In terms of alternative solutions to the problems of interconnection, Figure 1 represents a cordless MPEG link approach. Assuming presentation is the major requirement; this could imply simple one directional MPEG streaming from source to sink (left to right, or right to left, in the Figure). The approach keeps the 1394 buses (clusters) entirely separate, that is to say without requiring communications over the RF link to be 1394 compliant. The receive side must have the ability to control the signal originating devices (sources) within the 1394 cluster on the send side.

The gateway (1394 cordless AV adapter) is a special HAVi Full AV controller (FAV) device. The 1394 cordless AV adapter hosts Device Control Modules (DCMs) of devices located on remote 1394 buses (if necessary, more than one bus can be linked to, for multicast purposes). This implies all devices that are hosted must have uploadable DCMs. In Figure 1, this is illustrated by the shaded boxes attached to each gateway device: in these shaded boxes are the "proxy" DCM's of selected products located within remote clusters. The communication of HAVi commands across the radio link can be performed in any way, including proprietary methods. AV stream routing (e.g. MPEG) may be done using 'virtual 1394 plugs' (these would be

co-ordinated with the RF addressing to direct the stream to the correct target 1394 cluster).

An alternative arrangement of interconnected clusters is shown in Figure 2. The first cluster 50 comprises a STB 52 linked to a gateway device 59 by 1394 bus 58. Instead of RF transmission by the gateway 59, the first cluster includes a personal computer (PC) 54 or similar device which receives the MPEG from the gateway 59 as well as the HAVi commands to go to a remote cluster.

The second cluster 60 comprises a digital TV/VCR unit 62 linked to a gateway device 69 via 1394 bus 68. As for the first cluster, a PC 64 is connected to the gateway 69: in this example, communication of MPEG and the HAVi commands is accomplished between the PC's 54, 64 via wireless link following IEEE 802.11 WLAN standards. Available cordless data links following these standards include Diamond HomeFree (which has a data rate of 1Mbps) and RadioLan (10Mbps).

In general, such an arrangement is less favoured than that of Figure 1 in that a certain amount of buffering is liable to be required at the send and/or receive sides, although this can simply be provided by the PC's. The arrangement does have benefit in that it can accomodate devices unsuited for connection to the 1394 bus of a cluster: in Figure 2 this is illustrated by analogue TV/VCR 67 adjacent the second cluster which is supplied with images from an MPEG decoder 66 fed directly from the PC 64 of the cluster.

A further interconnect arrangement is shown in Figure 3 and comprises three clusters 70, 80, 90 each having a respective gateway device 71, 81, 91. In this example, the bridging between the clusters is by full cordless communications and at data rates determined by the cordless protocols used.

In the interconnect arrangements described, a number of improvements are provided, the first of which may be described as the provision of mobile DCM's – that is to say DCM's crossing from one cluster to another. HAVi describes the Device Control Module (DCM) software which represents (or is an abstraction of) the control system of a physical device. This software can be run on another device that is capable of running such software. For

instance, the DCM for a D-VHS recorder can be run on a Set Top Box. Currently, HAVi assumes that all devices in the network are connected on one single bus. The present invention extends this by providing for the DCM's to cross over the bridge. By having a representation of the remote device on the near side of the bridge, bridging problems can be greatly simplified as the remote device is apparently now on the near side of the bridge. In other words, there is provided software on one side of a bridge between buses which represents a device on another bus which is connected to another portal of the bridge.

A further improvement relates to the usage of so-called Legacy devices within the HAVi V1.0 specification. Legacy AV devices (LAV's) are already defined in HAVi and allow non-HAVi devices to be accessed and controlled by a HAVi network, by the use of DCM's (mentioned above). In effect, the DCM for a Legacy device is a bridge between a HAVi network and the native control of the Legacy Device (e.g. the above-mentioned D2B protocols). In this way, non-HAVi devices can be made to appear like a HAVi device on the HAVi network. This idea extends this mechanism to allow control of real HAVi devices on the far side of a bridge via the representation of that device on the near side of the bridge.

A still further improvement relates to the modification of Virtual plug parameters. HAVi already describes the capabilities of a connection by assigning parameters to "virtual plugs" situated at each end of the connection path. In a bridge, parameters such as bandwidth are limited and are less than the capabilities of the actual physical device. The modification allows the representation of a remote device on the near side of the bridge to be modified to make allowances for the limitations of the bridge transport medium (e.g. RF).

From reading the present disclosure, other modifications and variations will be apparent to persons skilled in the art, including equivalents and features which are already known in the field of bus-connected and cordless communication systems and components and which may be used instead of or in addition to features already disclosed herein.

CLAIMS

1. A local communication system comprising:

a first cluster of devices interconnected for the communication of messages via a first data bus and in accordance with a first set of communication protocols;

a second cluster of devices interconnected for the communication of messages via a second data bus and in accordance with said first set of communication protocols; and

a data channel linking a device of said first cluster and a device of said second cluster, said data channel supporting communication of messages in accordance with a second set of communications protocols;

wherein a device of the first cluster holds a stored software representation of operational features of a selected device of the second cluster and any device of the first cluster wishing to interact with said selected device instead interacts with said stored representation.

2. A system as claimed in Claim 1, wherein said stored representation is generated by said selected device and transmitted via said data channel to said device of the first cluster.

3. A system as claimed in Claim 1 or Claim 2, wherein said stored representation is modified in response to limitations of said data channel.

4. A system as claimed in Claim 2, wherein said stored representation is modified, on receipt by said device of the first cluster, in response to limitations of said data channel.

5. A system as claimed in Claim 1, wherein said stored representation models said selected device as if it were a device of the first cluster.

6. A system as claimed in any of Claims 1 to 5, wherein the said device of the first cluster holding the stored representation is that device of the first cluster to which the data channel is connected.

7. A system as claimed in any of Claims 1 to 6, wherein said data channel is a wireless link.

8. A communications device having the technical features of a cluster-connected device in a system as claimed in any of Claims 1 to 7.

9. A local communication system substantially as hereinbefore claimed and described with reference to the accompanying drawings.

ABSTRACT

CLUSTERED NETWORKED DEVICES

A local communication system comprises a first cluster (10) of devices interconnected for the communication of messages via a first data bus (18) and in accordance with a first set of communication protocols, a second cluster (20) interconnected via a second data bus (28) and following the first set of communication protocols; and a data channel (41) linking a device (19) of the first cluster (10) and a device (29) of the second cluster (20). The data channel (41) suitably comprises an RF link supporting communication of messages in accordance with a second set of communications protocols. A device (19) of the first cluster (10) holds a stored software representation of operational features of a selected device (DVHS-2) of the second cluster (20) and any device (11) of the first cluster wishing to interact with said selected device (DVHS-2; 22) instead interacts with said stored representation.

(Figure 1)

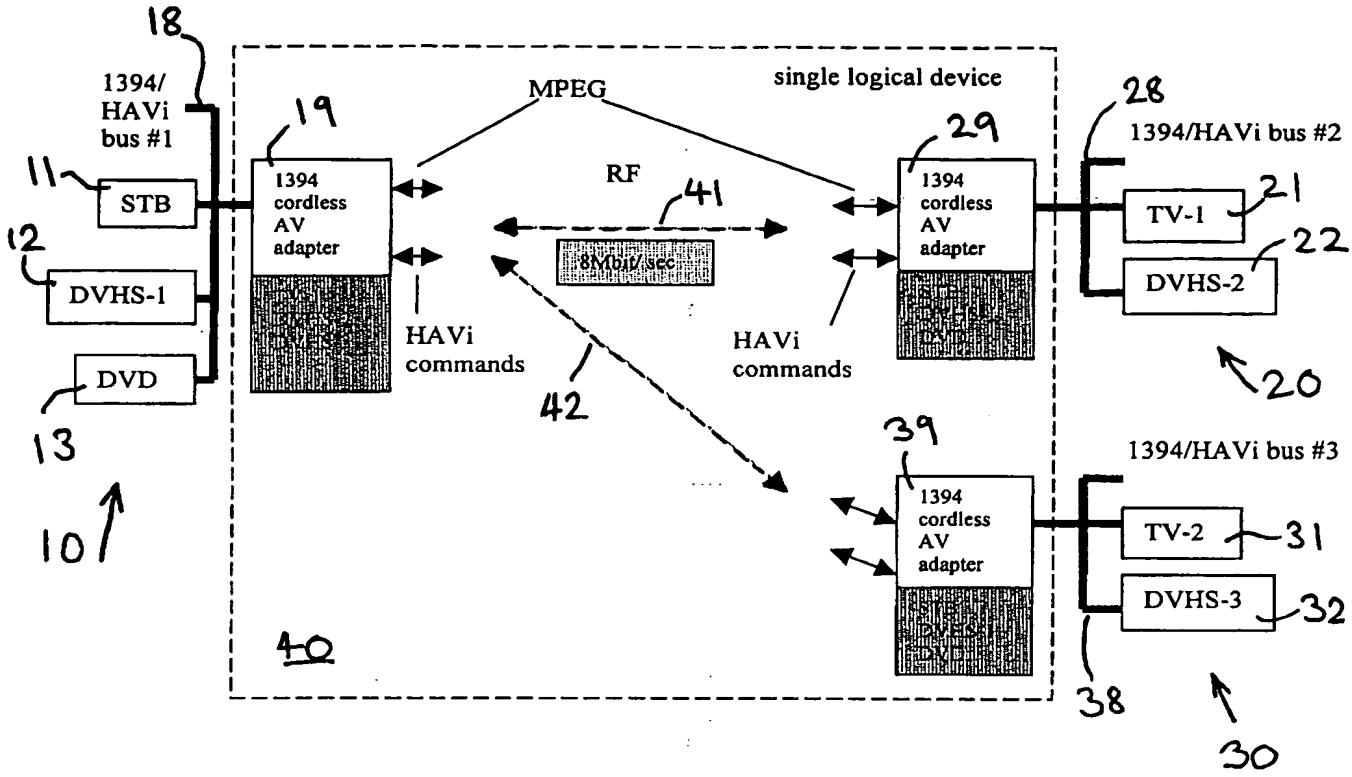

Figure 1

PHB 34387

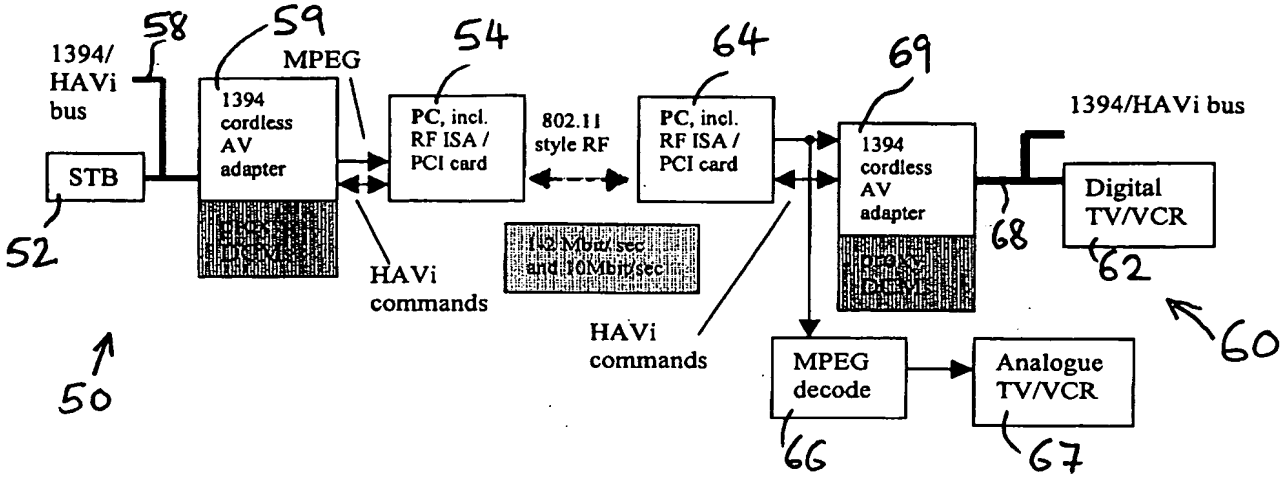

Figure 2

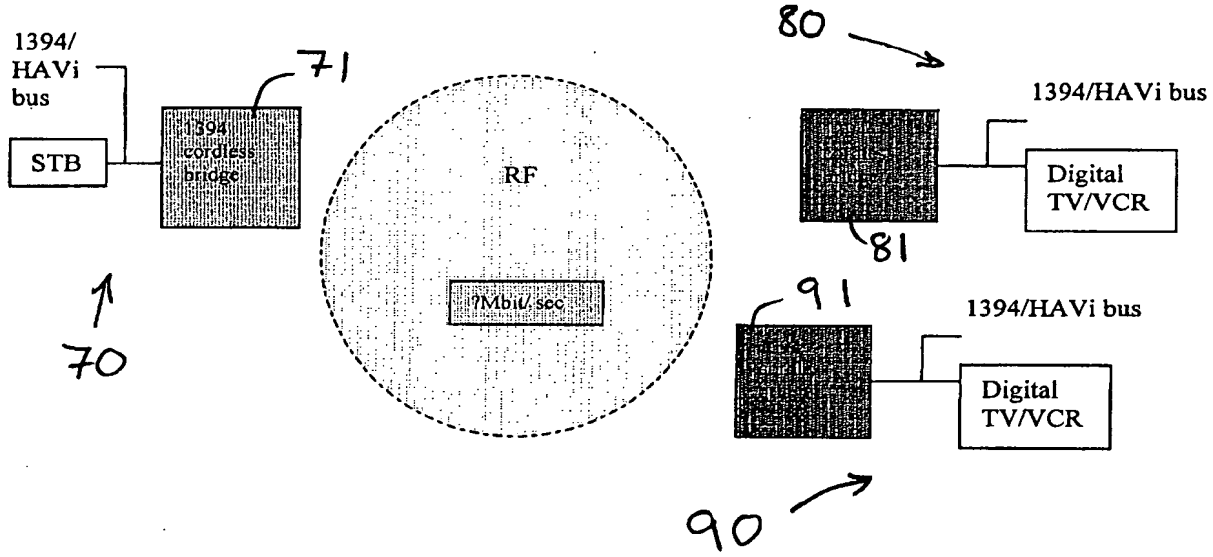

Figure 3

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